2: Jochelson E-5 (1884-1902) 1933 Yakut

tions, not only those living on the surface of the earth or in trees, like the squirrel, the flying-squirrel (*Pteromys*), polar hare, wolf, elk, reindeer, musk-deer, mountain sheep, and others, but also those burrowing in holes and dens, like bears, otters, foxes, marmots, spermophiles, mice, lemmings. According to the reports of hunters, some of the animals which ordinarily live in dens build their nests in hollow trees, because of the swampiness of the upper strata of the ground. 134

Of greater interest is the important rôle this frozen soil plays in the conservation of the remains of the extinct mammoth and rhinoceros. These are found, not in the ice itself, but in the earth above it. The mammoth belongs to the post-Tertiary or Pleistocene epoch and was contemporaneous with man. Its remains were found in central Europe, northern Asia, and the northern part of the American continent; the still extant rhinoceros is no longer found in Europe and North Asia. In America it became extinct before the end of the Pliocene period.

The underground ice of Alaska and northern North America, in general, has been described by many American explorers. One of the latest is Vilhjalmur Stefansson. However, nowhere in America are ice beds known to extend as far to the south as they do in northern Asia.

The Tundra

The usual conception of the whole northern region as a swampy tundra sloping down to the Arctic Coast is not quite correct. Northern Siberia includes several mountain ranges which in many places extend to the Arctic Coast and continue on to the islands in the Arctic Ocean. The greatest extent of tundra-like plains is found in the valleys of the middle and lower courses of the great rivers and their tributaries. The largest swampy tundras are found between the Kolyma and Alaseya rivers and in the valley of the Indighirka River. These areas are studded with many lakes, large and small, connected with one another or with the great rivers by small streams. Since the underground glaciers thaw out late in the season in summer, these swampy tundras constitute a greater barrier to communication than the mountain ranges. Consequently, the Yakut saddle and pack horses, as well as the Tungus riding reindeer, sink into the swamps up to their bodies. As might be expected, under such conditions, long journeys or nomadic camps are very rare in the summer. 133

The natives call treeless places on hills or mountain slopes "dry" or "stony" tundras. Many of these dry tundras skirt the swampy areas and thus afford passable detours as substitutes for the shorter routes through the almost impenetrable swamps.

2: Jochelson E-5 (1884-1902) 1933 Yakut

Orography

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The Verkhoyansk, a section of the Stanovoi Range, is the most important mountain range in the Verkhoyansk-Kolymsk country. It branches off from the latter near 140° east, Greenwich, and extends westward in the form of a bent bow, to the eastern bank of the Lena River. In many places the Verkhoyansk Range reaches a greater altitude than that of the Stanovoi Mountains. For instance, the pass from Yakutsk to Verkhoyansk, according to my own determinations, is at an altitude of 1550 meters above sea level,[1] while the neighboring mountain tops, which are bare ridges or peaks separated by deep ravines rise from 250 to 350 meters above the pass. On the other hand, the pass over the Stanovoi Mountains, which I crossed on my way from the Gishiga Valley to the Omolon River (1902) is only 900 meters high.[2]

The Verkhoyansk Range consists of several parallel ridges and the spurs, branching off from it almost at right angles, form the watersheds of the rivers which, rising in the Verkhoyansk Range, flow to the north. The following are the chief spurs of the Verkhoyansk Range, on the north, toward the Arctic Ocean: 1, the Kharalakh Mountains which form the watershed between the Lena[3] and Yana rivers; 2, the Tas-Khayakhtakh Range, between the Yana and Indighirka rivers; and 3, the Tomuskhaya Range, between the Indighirka and Kolyma rivers. This last divides into two ranges at about 67° north latitude. One branch, called the Polovinsky or Polovinovsky Range, forms the watershed between the Kolyma and Alaseya rivers; the other, the Alaseya Range, separates the Alaseya and Indighirka rivers. The last of these ranges forms the chief branch of the Tomuskhaya Range. All these ranges slope somewhat toward the ocean and their height, which is from 400 to 1000 meters, is not such as to constitute a barrier between the western and eastern parts of the country. The river valleys serve as a means of intercourse in a meridianal direction. The Kolyma River is about 1243 miles long; both the Yana and the Indighirka rivers are about 932 miles long.

Returning to the orography of the Verkhoyansk-Kolymsk region, it should be noted that Chersky, the geologist, en route from Yakutsk to

[1] Baron Maydell, as well as Doctor Bunge of Baron Toll's expedition found it to be about 1900 meters. Maydell, Baron Gerhard, Reisen und Forschungen im Jakutischen Gebiet Ostsibiriens in den Jahren 1861–1871 (*Kaiserliche Akademie der Wissenschaften*, Vol. 1, St. Petersburg, 1893; Vol. 2 and Atlas, St. Petersburg, 1896). Vol. 1, 33.

[2] The highest pass of the Stanovoi Ridge, en route from Yakutsk to Udskoi-Ostrog, a settlement at the mouth of the Uda River, as determined by Middendorff (Reise, I, 123), is 1260 meters. The two highest peaks of the Stanovoi Ridge on the way from Yakutsk to Okhotsk are 1260 and 825 meters high, respectively, according to Ermann (II, 378, 382). According to Stephanovitch (*From Yakutsk to Ayan*, Irkutsk, 1896 [in Russian], 106-108) the two passes between Yakutsk and Ayan are 940 and 996 meters high.

[3] It should be noted that the Lena River which is about 4260 miles long does not rise in the Verkhoyansk Range, but far south of Yakutsk Province in the low mountains of Cisbaikalia, at no great distance from Lake Baikal.

2: Jochelson E-5 (1884-1902) 1933 Yakut

Verkhne Kolymsk through the upper course of the Indighirka River determined the greatest height to be 2362 meters,[1] while recently, another geologist, Sergei Obruchev, observed a maximum altitude of 3300 meters[2] in the upper course of the Indighirka River. His statements concerning the inhabitants of the region are not consistent with the actual facts. He believes the Yakut are Mongol and that the Tungus are the aborigines of the country. Actually the Yakut are Turkic. Both tribes are immigrants: the Yakut from the Baikal country and the Tungus from the Amur region, or perhaps from southeastern China.

Flora

Despite the vast extent of territory between the Kolyma and the Lena rivers and the Verkhoyansk Range and the Arctic Ocean, the flora is confined to few species. This may be explained by its geographical position and the severity of the climate. Wherever the growing period lasts only about three months the flora cannot be rich. Of trees there are but few species. Of pines there are only the East Siberian larch (*Lariz dahurica*)[3] and the stone pine (*Pinus pumila*). None of the other Siberian coniferous trees, such as fir, pine, spruce, Siberian larch, are found north of the Verkhoyansk Range. The spruce disappears to the north of Olekminsk[4] in the Lena Valley.

Of deciduous trees, we find two species of poplar, the aspen, the birch, and several species of willow. Usually, the northern limit of arboreal vegetation is placed at the sixty-ninth degree of latitude, but east of the Kolyma River it lies farther to the south, reaching the sixty-eighth degree of latitude at Chaun Bay, while at Bering Sea it does not extend beyond the sixtieth degree of latitude. As a matter of fact, the northern limit of tree growth cannot be definitely delineated, for, varying with local conditions, it extends into the tundra generally following the river valleys; sometimes the Arctic tundra cuts deeply into the tree zone. In addition, south of the northern forest limits are sporadically scattered tracts of treeless tundra of various sizes, altogether similar in character and vegetation to those in the Arctic zone.

The tree found farthest to the north is the East Siberian larch which like the American fir also reaches the highest altitudes. I observed it

[1] Chersky, I. D., Preliminary Account of the investigations of the Kolyma, Indighirka, and Yana River Region (*Supplement to Vol. 73, Memoirs of the Imperial Russian Academy of Sciences*, St. Petersburg, 1893).

[2] Discovery of a Great Range in North-East Siberia (*The Geographical Journal*, vol. 70, pp. 464–470, London, 1927).

[3] To the west of the Yenisei River is found the Siberian larch (*Lariz Sibirica*) instead of the Dahurian larch.

[4] East of the Stanovoi Ridge the spruce disappears near the Uda River and the pines and firs extend only as far north as Okhotsk.

2: Jochelson E-5 (1884-1902)1933 RV2Yakut AV2
HISTORICAL SIBERIA RR2

HISTORY OF CONTACT WITH RUSSIANS

Y 173 The Yakut once lived in southern Cis-Baikalia and earlier, possibly, in the Sayan Mountains. Under pressure from the Mongol-Buryat, they wandered into the Lena Valley occupied by Tungus tribes, whom they forced to retreat from the valley into the mountains. These events which occurred in the thirteenth or fourteenth century of our era, naturally could not be recorded in the old Russian annals. Our information is based on oral traditions, preserved among the Yakut.

HS 175 651 Y 175 We have previously noted (see p. 64) that the Yakut were subjugated by two different Cossack parties from Mangasey aand Yeniseisk. The Olekminsk fortress on the Lena River was erected in 1630 when only Tungus lived in the region. In 1637 a Cossack party, under the command of Busa, collected tribute in furs from the Yakut of the Yana River.

In 1638 the Cossack elder, Postnik Ivanov, with a party of twenty-seven men, left Yakutsk on horseback, crossed the Verkhoyansk Ridge and entered the valley of the upper course of the Yana River, meeting first Tungus, and later Yakut.

In 1641 a Cossack party, under the command of Stadukhin, journeyed to the northeast of Yakutsk and reached the tableland, Oimekon, on the upper course of the Indighirka River. There they met Reindeer Tungus and cattle-breeding Yakut and exacted fur tribute from them.

HS 162 Y 167 In 1675 there were in Olekminsk 206 tribute-paying Yakut and Tungus; forty years previously there were no Yakut in Olekminsk. On the Viliui River were three camps of Tungus and Yakut, totaling 1005 men; in Shigansk were 332 Yakut and Tungus; in Verkhoyansk 125 Yakut tax payers.

HS 175 651 Y 175 By 1620 a report had reached Tobolsk from the Mangaseya Cossacks of the Great (Lena) River and the Lena Yakut. In 1631 they descended by the Viliui River, a tributary of the Lena, to the Lena River and imposed tribute on the adjacent Yakut. In 1632 a party of Cossacks under the command of the Boyar's son, Shakhov, took tribute in sables from a clan of Viliui horse-breeding Yakut. The Viliui River farther up from its mouth was occupied by Tungus only. The northern boundary of the distribution of the Yakut at that time was the mouth of the Viliui. The whole Lena Valley from the mouth of the Viliui River to the south, at a distance of about 500 kilometers (or 310 miles) was occupied by Yakut. In their possession were also all the Lena islands of that region, rich in

Y 131 133 361

2: Jochelson E-5 (1884-1902)1933 RV2 Yakut RV2
HISTORICAL SIBERIA RR2

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pasture lands. There is no definite information as to how far inland they penetrated at that period. We may admit, however, that the Yakut, being horse and cattle breeders, were hardly inclined to move into the dense forests far from the majority of their tribesmen, i.e., far from the Lena Valley. In the beginning of the seventeenth century the Yakut abode on the western banks of the Lena must have been the territory of the two present *uluses*[1] of Yakutsk District, Namskij and Western Kangalassky. There, according to Yakut traditions, was the first place of refuge of their mythical forefather, the "Tatar" Ellici. From there a part of his nearest descendants could also have emigrated over the Lena islands to the eastern banks of the Lena River, where excellent pastures are as abundant as on the western banks.

At the time of the Russian invasions the Yakut were already the owners of the central part of the trans-Lena tableland. They had settlements on the tributaries of the Aldan River, the largest of the western tributaries of the Lena, and on the Amga River, a tributary of the Aldan. But the most populous locality appears to have been the western part of the Lena Valley between Tabaginsky Cape and the Kangalassky promontory. This valley is about 70 versts (46.2 miles) long and the bank ridge retreats from the river at a distance of from three to six versts (from two to four miles). Lake Saisary lies almost in the middle of this valley. This is the largest open plain encountered in Yakut territory with the densest population of horse and cattle breeders. The owners of this valley, the Kangalassky, constitute, according to all Yakut traditions, the most powerful group of clans. The Kangalas Toyon (prince, elder), Tygyn, is depicted in legends as their absolute ruler, although these clans were nominally considered as independent divisions.

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In 1632 the Russian invaders erected a little fortress called Lesnoi Ostroshek, on the eastern bank of the Lena; ten years later they transferred it seventy kilometers to the south, where it became the center of the territory under the name of the City of Yakutsk. The fortress, now the City, of Olekminsk was erected by a Cossack party under the command of Buza in 1635. In the summer of 1637 Buza built two flat-bottomed ships, called *kocha*, and descended to the mouth of the Lena River, and traveled in an easterly direction on the Polar Sea. Not far from the mouth of the Omoloi River he was barred by ice and was compelled to abandon his ships. For three weeks his party walked over mountain ridges until they arrived at the upper reaches of the Yana River, where they met Yakut and took many sable skins from them as tribute.

[1] For the meaning of the administrative divisions of ulus, nasleg, and clan see p. 47.

9: Stadling--82-85 E-3 (1898) 1901 Yakut
116, 133

"The perennially frozen soil begins in the southern parts [83, 84 contain photograph] [85] of Yakutsk. In the neighbourhood of the city of Yakutsk, according to the calculations of the savants, the earth is frozen to a depth of 1000 feet! This ever-frozen soil exerts a great influence on the configuration of the lakes and rivers. It prevents the absorption of the water by the earth. There are no springs and no subterranean waters. This accounts also for the very great number of lakes and marshes in northern Siberia. For the same reason the rivers very rapidly swell above their normal limits, causing at times most disastrous inundations."

9: Stadling--78 [2] E-3 (1898) 1901 Yakut
116, 131, 133

"According to the calculation of General Strelbitsky, the area of the province of Yakutsk comprises in round figures 3,900,000 square kilometres, i.e. as much as the whole of European Russia with the exception of Poland and Finland. Orographically it may be naturally divided into two parts--namely, the lowland west of the Lena, through which only a few less important mountain ridges run, and the immense region to the east of that river, traversed by the great chain of the Jablonoff mountains, which in some places to the south-east reach a height of nearly 7000 feet, giving to this part of the province the character of a mountainous region."

10: Bush--160-161 T-3 (1865-67) 1871 Yakut
116, 177, 101, 133

"The Yakouts inhabit that large extent of country lying in the interior west of the town of Okhotsk, and on the Lena River, where is a city called Yakoutsk, of about 15,000 inhabitants, the greater part of whom are Yakouts. This city was founded in the year 1632 by the Russians, and has ever since been one of the most prominent Russian towns in Eastern Siberia. It contains a number of good buildings, and is the [161] centre of a very large trade in furs, for which nearly all domestic articles are given in exchange. It is the principal emporium of this whole section, and is connected by government post-roads with Irkoutsk, the capital of Eastern Siberia; Colema, on or near the Arctic; Ajan and Okhostsk, and, by way of the latter, with all of Kamtchatka. Most of the Yakouts, from constant intercourse with the Russians, speak the Russian language, and have adopted their manners, customs, and religion."

24: Wrangell--164 G-3 (1820-23) 1842 Yakut
116, 133, 361

"The vegetation is especially luxuriant in the albuty, or dried-up lakes, which are numerous in this district, and form one of the peculiar features of Northern Siberia. These flat valleys are occasionally filled with water by the overflowing of the rivers in spring, when they are converted into lakes of various sizes, all abounding in fish. The intense frosts of winter cause large clefts in the ground, by which the water drains off, sometimes in the course of a single year, sometimes in several. The rich alluvial soil thus exposed soon becomes covered with a luxuriant growth of the finest grass, and the Jakuti never fail to settle near these fresh pastures, so that most of the settlements in this district are called albuty. (1)

1. A curious phenomenon occurs in the lakes in the vicinity of the village of Alaseja. In the middle of the winter the water sometimes suddenly disappears, without any side channels being visible. In such cases a loud noise is heard at the time, and when the bottom of the lake is laid bare, large fissures are visible, occasioned by the severity of the frost."

28: Grigoriev--176-181 N-5 (1925) 1926 Yakut -1-8
116, 133

[LSS: For a discussion of the area analysed, see category 134, pp.171 ff.] In its geomorphological aspect the forms of relief of the Region described may be characterized as being of three types: that of a hilly country studded with lakes, of a hilly country intersected by valleys, either of these in various modifications, and, lastly, as that of the valley type alone. The most usual and characteristic form of relief of this region is the first of these three, particularly well developed in the southern part of the region visited, and constituting a wide belt down the right bank of the Lena, as well as similar belts extending in a northerly direction. One of these belts lies along the meridian of the Dygdala shore, whilst another runs nearly along that of Borogontsy. The first is even continued beyond the north bank of the Aldan, although interrupted by a rather narrow belt of hilly valley country. Between these belts extend zones of this latter type, likewise disposed in a meridional direction. A zone of that kind stretches to the east of the Borogontsy hilly country-lake zone, and yet another similar one is apparently situated between the just mentioned Borogontsy and the Dygdala-Dupsun hilly country-lake zones, although it is better developed as it approaches the Aldan, extending but little to the south, so that at this spot all the three belts of the hilly country-lake type merge together. It is very difficult, however, to give an exact account of the distribution of these types of relief in view of the absence of a topographical survey of the whole country. According to oral information derived from local sources and to field sketches of the maps of the

naslegs (minor administrative units) of the Borogon- [177] ski ulus (a major administrative unit) in the eastern part of that ulus the lakes are much less numerous than in the western: the hilly-valley and the pure valley type of relief evidently predominate in the eastern part, although the general surface of the country is here considerably flatter than in the west.

The principal axis or backbone of these hilly-lake belts may be characterized as exhibiting the greatest degree of dissection of the relief. The height of the ridges, or, which comes to the same thing, the depth of the depressions, reaches here 50-60 metres, the ridges between the depressions being often very narrow, sometimes not more than 50-100 m wide, their sides steep, the tops of the ridges being flat or hilly. The depressions extend over a larger area than the ridges. Their bottoms are generally filled with lakes, which in this part of the country acquire their greatest dimensions. In this 'backbone' region of the hilly-lake belts the lakes in general completely fill up the bottoms of the depressions, although not infrequently containing islets which emerge above the surface of the water; the cases are less frequent when the lakes occupy the deeper parts of the depressions only. The shape of these lake depressions is not uniform: thus, in the region of Borogontsy the lakes are mostly all but circular, in the zone of Dupsun they are very generally of an elongated form; long inlets of water disposed as a rule along the meridian with a slight deviation towards NNW or NNE are still more frequently found in the latter zone, of which these inlets are particularly characteristic; they often abut upon

steep cliffs, which form closed amphitheatres. No less characteristic of the lakes in this belt are slightly curved land spits, which extend far into the lake, especially at the entrance to the inlets described above, the channels to which they obstruct. The great majority of the lakes of the 'backbone' region of the hilly-lake zone possess no perennial outlets; if ever such are provided they represent beds, situated at a considerably higher elevation than the summer level of the water in the lakes. In spring, when the level of the water in the lakes rises (according to local information to a height of 2 to 6 m) a discharge of the water may frequently be effected. In the majority of the lake depressions examined, however, no vestiges of a drainage of any kind could be observed; at the same time in many of the lakes the water is of a sufficiently unpleasant taste [178] to suggest the initial stages of its becoming salt. Judging from local information, however, true salt lakes in this region are extremely rare. It should be added that the lakes of the zones described are usually situated at various altitudes and the difference may amount to 20 metres, although generally not so much. The zones described usually represent watersheds and are not traversed by streams or watercourses of any size. The relief both east and west of the 'backbone' gradually flattens out. This flattening consists in the gradual decrease in the height of the ridges which do not exceed 10-20 m of absolute altitude, their width at the same time very much increasing; the number

of lake depressions slowly diminishes, although remaining pretty considerable; on the other hand, depressions covered with meadow occur more frequently, a few puddles alone remaining from the former lakes. The number of lakes with islands in their centre, more often flat, sometimes in the shape of slight eminences, with well defined cliffs, increases. The steep cliffs of these lake depressions become lower as these latter are further removed from the 'backbone' of the zone in question, dropping to 3-5 m in height, instead of 40-50 m, as is the case in the region of the 'backbone', and eventually disappearing altogether, being supplanted by very gentle slopes. These lake depressions, as well as the lakes themselves also diminish in size, while the beds of the lake outlets, like narrow creeks, generally dry in summer, become prominent. Lakes without any outlets, however, occur here also. Finally, small streams, although not often, appear: some of them look normal enough and flow in well worked out meandering valleys, while others (which are met with more frequently) consist of a chain of lakes, connected with each other by channels, which, when the water level is low, dry up in summer.

It should be noticed that the effects of the different component parts of the subsoil (clay or sand) on the structure of the relief, if observable, are restricted only to minor details. Evidently the permanent ice which equally consolidates clays and sands renders both these rocks nearly identical in the effect they have upon the moulding of the relief. It is remarkable, that no transition zone exists; between the valley of the Lena proper

and the contiguous hilly-lake zone, in approaching the steep country rock margin of that river's ancient valley, the hilly-lake belt abruptly terminates. This circumstance is especially [179] worthy of notice, as the valley of the Lena is 40-60 m deep, so that all the conditions requisite for the development of receding erosion from the side of the river seem to be in evidence. Yet, signs of erosion, as a matter of fact, are totally absent, and this may be accounted for on the one hand by the frozen state of the sands, and on the other by the rain and spring waters being completely absorbed by the numerous lake depressions of the plateau, which, in connection with the powerful summer evaporation, part with a great quantity of water, and never being full to the brim, are unable to produce water courses flowing in the direction of the Lena. The river valley of the Lena seems to be of quite recent age in this district (1) and could not be formed prior to the

1. This observation must not be understood to refer to the age of the Lena valley both above and below the region of the Pre-Verkhoyansk depression, which in the beginning and middle of the Quaternary period was a lake, into which the Lena fell and from which it flowed out.

disappearance of the dislocated basin, bordering on the Verkhoyansk chain from the south, which was filled up by sediments of Quaternary age.

to occur. This section of the hilly-valley 'landscape' interrupts the further development of the hilly-lake relief. Being characterized by wide, nearly dry valleys, similar to those described above, but possessing a greater width, this belt may be further distinguished by the valleys having numerous branches, often ending blindly. Such palmate shaped systems of valleys, with clearly expressed bluffs 3 or 4 m. high, are separated from one another by low valley divides and are not infrequently grouped together around a smooth flat area, forming the bottom of a former lake. Sometimes, especially in the knots of the intersection of such valleys, these latter are studded with pools and lakelets, the level of the water of these latter being flush with the bottom of the valley. It is obvious that we have to deal here with the remains of a system of lakes, which possibly had numerous bays and had been at the same time connected with each other by channels; the filling up of the depressions with sediments and the drying up of the lake system has here progressed much further, than had been the case with the first of the hilly-lake regions described, to which the presence of a narrow, but sufficiently deep valley, cutting through the neighbouring high bank of the Aldan and providing the drainage for the locality described, may have contributed; by these means the lake depressions had lost their water, and the spring waters which accumulate in the above mentioned systems of palmate depressions possess a free access to the Aldan.

Conversely, the eastern slope of the hilly-lake belt bordering on the Lena and inclining towards the Tanda river valley, bears all the marks of a transition hilly valley relief.

True, the fllattening [sic] of the relief analogous to what has been described of the western border of the Lena zone may be observed here also, the number of depressions occupied entirely or to a great extent by meadow increases here just as much, but these depressions differ in being connected together by narrow gorges with a slightly concave bottom along the central line, their lowest parts being overgrown with belts of reeds, while to the right and left extend bush-like growths of the stunted birch Betula Middendorfii and B. fruticosa. The old shore lines of these valleys are well expressed and, though not high (2-3 m), are fairly steep. It is characteristic of these valleys, that the dip of the bottom is conspicuous enough to be visible and is usually inclined towards the nearest depression, so that one section of the valley has a fall in one direction, the other in another, the central piece being occupied by the watershed of the valley. In rare cases, a miniature recent gorge, in summer as destitute of water as the valley itself, may be observed to be cut into the [180] flat bottom of such a valley. In spring these valleys are naturally full of spring waters, to the action of which they owe their origin.

North of Aldan throughout a distance of ten kilometres from the old shore lines of the ancient river valley, nearly opposite the Dygdala shore, a type of hilly-valley landscape, allied to the one described above, but possessing original features, is observed

A third variety of the hilly-valley relief may be found on the eastern gently sloping declivity of the Borogonsk hilly-lake belt. The hilly-valley relief is here modified in the lakes (often elongated) being grouped together in common wide valleys, bordered on the right and left by high ridges, while the divides between lakes become much lower; the latter lose in height in the direction towards the E, and ultimately fall to an elevation of a few metres; these divides are mostly cut through by the valleys of small narrow channels, which connect series [181] of lakes into one system. Further E the size and the number of lakes diminish, and the valleys becoming somewhat narrower tend to resemble those described N of the Aldan (i.e. the second variety of the hilly-valley relief): they represent beds dry in summer, with fairly steep country rock margins of about 5 m high, with numerous branches, often terminating in blind amphitheatres, bordered by steep walls; the beds of the principal valleys are now and then studded with pools and small lakelets, the level of the water being flush with the bottom of the valley. Still further E the relief is modified anew and a belt of wide and flat depressions, sometimes possessing lakes, but oftener their remnants only, or being wholly destitute of them, are encountered, these depressions being connected together by narrow, dry (in summer) valleys, by means of which they are joined with the valley of the Tanda; this variety of hilly-lake relief is similar to the first described above.

The third type of relief-the valley type-is expressed in its purity in districts traversed by considerable streams: in the region under discussion such streams are the Lena, Aldan, Tanda and Tumara."

"The valley of the Lena is bordered on the East by a high main bank (40-60 m high), which occasionally has an abrupt drop to the flood plain below lying at an altitude of 4 m. above the river, but is generally skirted by two terraces lying at a height of 10 to 15 m above the river flat. Not infrequently these terraces widen out to a very considerable extent affording sufficient space to be occupied by villages and arable lands. Both on the bottom lands, and on the terraces immediately above them occur (in the vicinity of Yakutsk) small circular marshy lakes containing flat islets, or loop-shaped cut-offs surrounding somewhat more elevated islets. Here and there these islets bear signs of being cleft by deep fisures which extend along their longitudinal axies. The origin of these fissures, as well as of the flat islets is due to the vigorous freezing of the soil.

The valley of the Aldan possesses also extensive bottom lands with cut-offs. The height of the old shore lines reaches 60 m. and more. Two high terraces are present: one at an altitude of 15-20, another at that of about 30 m. The latter is frequently very much eroded, leaving remnants in the shape of the residual detached hillocks and ridges.

[182] The height of the bluffs of the Tanda and Tumara seldom exceeds 30-35 m. Both rivers have made relatively deep cuts in their flood plains, the first to a depth of 6-8 m, the second--4-5 m. Residual hillocks and ridges, 8-10 m high above the river flat, is all that remains of the terrace skirting the latter.

The above features relating to the relief may be supplemented with certain particulars connected with the universal prevalence in the region of permanent and fossil ice.

To these particulars belong; 1) a very slight dissection of the steep declivities by ravines and gullies, which although occasionally present, and, of an insignificant length, may attain a considerable depth; a slight development of the receding action of erosion can only be explained by the frozen condition of the ground; 2) a peculiar microrelief of the steep clay banks, which seem to be studded with oval excrescences, formed at the expense of separate sections of the declivity being cleaved off by fissures caused by frost, and which thaw out in spring and form landslides; 3) peculiar, deep cirques or amphitheatral recesses formed at the points of the most intense thawing of exposed boulders of fossil ice aud [sic] being often nearly closed and having as points of outlet but very narrow gullies.

The form of the relief of the region described is thus a hilly-lake landscape, which at times strikingly recalls typical landscapes in Finland; this resemblance is especially great in the region of the prevalence of sands with their growth of pines. This resemblance, which suggests the glacial origin of the relief of the northern parts of the Aldan-Lena plateau, fails, however, to accord with the fact that, whereas in Finland the forms mentioned are situated between the centre of glaciation and its outer limits in the shape of terminal moraines, here the terminal moraines of the glaciers, which have descended from the Verkhoyansk mountain chain, are disposed much nearer to the chain and consequently the part of the plateau visited could not have been covered by them. On the other

hand, the cirques described above in the shape of circular depressions with steep sides, which at present are occasionally formed where boulders of fossil ice become exposed and melt, suggest the idea, that the lake depressions of the plateau are genetically connected with the processes of the formation of such cirques.

The researches of J.P. Tolmachoff and Vollosovich on [183] the fossil ice of the more northerly regions of the Lena basin have established the fact, that we have here to deal with masses of motionless firn, produced from snow, which appear to have accumulated in the depressions of the relief since the Glacial age. The complete resemblance in the structure of the boulders of the fossil ice of the Lena-Aldan plateau studied by the author with that described by the above mentioned investigators, compels us to admit that the fossil ice of the region under discussion possesses a similar origin and had arisen in the same age. The conditions for the accumulation of ice in the northern part of the Aldan plateau must have been very favourable at that time, as a depression was present, which although filled withthe stratified sedimental deposits of Quaternary age described above, undoubtedly yielded in height to the surrounding country. In the epoch of the most recent glaciation vast motionless firn fields thus extended south of the terminal moraines of the Verkhoyansk glaciers, and were strewn over with dust and silt by summer waters and wind. These sediments may have been carried not only from the north, but possibly in a greater measure from the south, where at that time reigned an arctic desert or

semidesert which afforded a wide scope for vigorous processes of weathering. It is not in vain that a sheet of loess loam extends far south over the plateau. That the firn fields were strewn over with particles of dust may be proved by the fact recorded by D. I. Melikov, an old inhabitant of the place fully worthy of credit, that a piece of fossil ice from an exposed section on lake Muru near Borogontsy, on being melted, produced a considerable quantity of fine brown clayey sediment. Still it must be admitted, that during the epoch of the most vigorous accumulation of firn the conditions for its being covered with drift could not be very favourable, as most of the latter must have accumulated in fissures and other depressions during the summer thawing of the surface of the firn fields, where it was deposited, often obtaining a stratified character, being frozen through and interpolated with thin layers of freezing water.

The process involved in covering the firn fields with loesslike loams and sandy loams and, in proximity to the Lena, originally with sands, must have been more vigorously carried out since the commencement of the recession of the Verkhoyansk glaciers, at which period the moraine drifts of these latter become exposed [184] and rendered more accessible to the action of running water and the wind, while the changes in the conditions of the climate could not but contribute towards increasing the bulk of sediments carried from the south. As the more prominent parts of the firn fields at that time commenced to thaw more vigorously, the sediments that had settled down on them must have been carried away, accumulating in the lower parts of the firn areas and

forming a mantle sufficiently thick to be able to protect the ice, buried beneath them, from thawing through the effect of the sun's rays.

These sediments had of course accumulated also in great quantities on tracts free from the firn covering, and presenting favourable conditions for that purpose.

Thus, owing to the protection afforded by these sediments during a considerable period of the recession of the Verkhoyansk glaciers the ice to the south of the Range did not disappear. The process of elimination of the ice had been retarded for a very considerable period and, as we have just seen, is not even yet over, in spite of the high summer temperatures of the present climate. Parallel however to the accumulation of the deposits described above, as soon as the climate began to change and to cause a vigorous recession of the Verkhoyansk glacier, separate boulders of firn ice more prominently protruding above the surface of the plateau, as they became sufficiently exposed to the action of the sun's rays, commenced, as we have seen, to thaw out. In such places were formed cirques of the kind described above increasing in area, and at length attaining the size of the present lake depressions, while the lower tracts of the firn fields, protected by deposits of sediment, remained very little altered and became gradually transformed into ridges, separating the lake depressions from one another; in such cases sheets of loam sliding down from above not infrequently could protect the ice walls, about to be exposed, from melting by enveloping them anew. Tracts, where

sediments accumulated on the ground and not on the firn, also naturally gave rise to ridges. The water, formed from the melting of the ice and accumulating in the growing cirques did not fill them to the margin through loss by excessive evaporation caused by the extreme aridity of the climate, which undoubtedly prevailed here towards the end of the Glacial Period. Thus, ever since the end of that period [185] and to this day thousands of closed lake depressions without outlet have been formed one after another on the site of former firn fields. Occasionally, in spots where the external conditions were favourable for that purpose and suitable sources of erosive activity were present, as in the neighborhood of large river valleys, these lake depressions were subject to further changes and the hilly-lake relief became transformed into one of a hilly-valley character.

According to inquiries from old inhabitants of the country made on the spot fossil ice seems to occupy considerable areas in the nothern [sic] parts of the plateau.

However that may be, it cannot be denied that this country has at the present time reached a stage which has been passed by the European North, although in a somewhat modified form, many thousands of years ago, and which corresponds to the latest periods of glaciation."

" II. Verkhoyansk mountain range.

Summarising the observations made in the region traversed by the Verkhoyansk-Tukulan road and lying east of the latter between Sartang on the one hand and Nyalgyakha River and Hongkui mountain on the other, a short account of the geological structure and geomorphology of the Verkhoyansk Range and of the southern border zone, situated north of the Aldan, may be given as follows.

The Verkhoyansk Range is formed of steep, somewhat assymetrical folds, closely pressed together and sloping generally in a NE direction, and is usually of a small transverse diameter of 2-5 klm. The direction of the strike of the rocks, as also of the folds, is characterized by its exceeding complexity in this region; on the southern border of the folded zone it approximates to NW, ranging between N 316° W and N 336° W, while on its southern limits in the Mollegoi hills it is N 339° W, in the Yakutsk Chain N 316° W and near Urlachi R. N 334°--344° W. In closer proximity to the mountain pass over the principal dividing ridge of the range, north of the mouth of Longitudinal Tukulan the direction of the strike ranges from NNW to an all but meridional position (from N 334° W to N 350° W); in the vicinity of the Jugjur Pass and of the northern slopes of the range the strike assumes a meridional direction varying from [186] N 356° W to N 4° E; further

north, on the Upper Kieng-Uryakh (Upper Yana) it reverts to NNW (from N 339°W to N 349°W) only to assume anew a meridional position (N 354°W and 6°E) further down that river; in one place, however, the strike was found to be N 344°W. In closer proximity to the confluence of the Kieng-Uryakh with the Sartang the strike again assumes a NNW direction (N 338°W to N 346°W), and again occasionally reverts to a meridional position (N 339°W to N 354°W) in the region of a section of the Yana called Sartang (north of the Kieng-Urgakh Chapel). East of this region between the valleys of the Yana (Sartang) and the mountain pass towards the Nyalgyakh valley the predominating direction of the strike is intermediate between NNW and NNE (N 344°W--N 8°E), only to range between NNW and a nearly meridional direction in the basin of the upper Nualgyakha (N 348°W --N 355°). The variation of the strike of the folds is thus tolerably uniform in the country visited and refers equally to the direction from the S to N as to that from W to E, these being the alternate routes followed by the exploring party. If this general statement be confronted with the fact of an apparently greater variation in the strike in separate sections of the route, when a tendency to assume a direction to the NE (N 49°E) or even ENE (N 69°E) may be observed, the conclusion is necessarily reached that the folding here must be very complicated and that either vertical bendings of the axis of the folds in regard to their strike, or else horizontal torsions in a direction transverse to the strike, or both, are here met with. It is to be regretted that owing to a very cursory

examination of these phenomena, incidental to the restricted time which was at the disposal of the author while crossing the Range, it was impossible to come to a more definite conclusion on the subject. However, it follows from the above that there is no serious ground for opposing the NW strike of the southern parts of the elevated tract under discussion to the NE strike of its more northerly portions, as is insisted upon by some authors, who attribute a different age to each of these foldings by referring them to deposits of various epochs. By this, however, the author does not mean to imply that the folding processes that have occurred here should be necessarily attributed to one and the same age.

The rocks which constitute the Verkhoyansk mountainous tract [187] are not conspicuous for diversity. The mostly consist of arkose sandstones, interstratified with finely grained sandstones, externally approximating to argillaceous schists, both locally containing a certain quantity of lime.

In some regions sandstones predominate, in other schists; thus, in the Yakutsk chain schists are nearly absent, and horizons of conglomerates occur in the midst of sandstones; conversely, the western slope of the divide between the systems of the Tangkhalakh and Nyalgyakh is composed all but exclusively of schists. Yet it is remarkable, that the arkose sandstones of the Yakut chain and of the adjacent region bordering on the north reappear on Hongkui mountain at the northernmost point reached by the expedition.

Occasionally, these rocks are replaced by dark grey, nearly black, calcareous sandstones merging into hornstones, and by arkoses of the same character, which constitute a massive layer on the south slope of the Dividing Range, and form a continuous zone between Byadya-kuel and the mouth of Longitudinal Tukalan; outcrops of such calcareous sandstones, but extending over a restricted area, occur also on the left bank of the Timirdyakh, directly north of the Yakut chain. Judging from the degree of metamorphism they have been subjected to, the age of those calcareous sandstones is more ancient than that of the remaining sedimental series; by analogy with the calcareous rocks of the more western parts of the Range they should apparently be referred to a Paleozoic formation. The thick layers of arkose sandstones, interstratified with rocks, in character allied to argillaceous schists, should on the other hand, by analogy with samples collected by Toll and Tscherski from other parts of the same Range, be refered to the Trais and possibly to more recent Mesozoic time; the arkoses of the Yakut chain of Hongkui belong here also.

Fossils (remains of plants) have been found by the author in the southernmost outcrops of the arkose-calcareous sandstones alone: although these remains cannot be identified, they should, in analogy to the outcrops of similar rocks on the south of the Lena-Aldan plateau, be Jurassic or Cretaceous. In this very layer have been found seams of productive lignite, evidently of the same age. There is every reason to expect the occurrence of such coals throughout the entire extent of the Range from the Mollegoi

hills to as far as the southern slopes of the Yakut chain, [188] a distance of about 20 kilom., where outcrops of the same suite are found east of Tukulan.

The character of the dislocation of these rocks fully agreeing with that of the mountainous region indicates the Mesozoic age of this last stage of the folding processes, to which in the opinion of V.A. Obruchev, an Upper Cretaceous age may be assigned. On the other hand, the exceedingly intricate character of the dissection of Paleozoic rocks seems to imply the presence of ancient folds, formed at the end of the Paleozoic era. Yet, the strike of the folds does not here seem to differ from that of the Mesozoic formation. At the same time, the abrupt outcropping of rocks collected in folds from beneath sediments, of which the low hills of Mollegoi 40 klm from Aldan and 20 klm from the Yakut Chain are formed, seem to indicate that their southeastern margin is severed off by a fault, down which the territory lying to the south subsided.

There are grounds for assuming that the Yakut Chain north of Timirdyakh is likewise skirted by a fault line, along which basalts were extruded. Finally, the exceedingly sharp and abrupt elevation of the southern slopes of that chain above the flattened surface of the sandstones and schists of the level foothill zone, dislocated conformably with it, leads to the same conclusion, that here also a fault line must have arisen.

In such case the Yakut Chain and the adjacent section of the valley of Timirdyakh should be regarded as having been produced by an upward thrust, the northern parts of which have been deeply indented by a valley, whereby in a zone of Mesozoic deposits Paleozoic rocks have been disclosed.

The Verkhoyansk Mountain Range thus seems to be skirted on the south-west by a belt of fault dislocations running parallel to it. These disjunctive dislocations seem most probably to have been formed in the Tertiary Period, or subsequently to the time when the folded tracts of country had all but assumed the character of a plain with a series of residual eminences.

In the Dividing Range and north of it the author met with no ostensible indications of thrust phenomena.

With reference to the tectonic features of the Verkhoyansk mountainous tract it should be noted that the south-western slope is in general steeper and shorter than the north-eastern, the elevations of the latter gradually diminishing in height and [189] extending for hundreds of kilometers nearly as far as Verkhoyansk; whereas the highest ranges of the whole country, the Dividing Range and Yakut Chain, are separated one from another by but 87 klm at most (as the crow flies), the former range being separated from the southern limits of the folded area by a distance of about 115 klm.

The altitude of the eminences of the Dividing Range in the region of the Jugjur pass reaches about 1800 m, the pass itself measuring 1438 m. The height of the range west of

the pass seems to diminish, while to the east it increases very considerably, although nowhere reaching the line of perpetual snow: in various spots, however, protected from the effect of the sun's rays, tracts and belts of snow persist throughout the summer. The southwestern slope of the Range gradually decreases in height in the direction of Byadyakuel, to the south of which extends a lower belt of an altitude of 800-1000 m, which continues to decline in a southerly direction. The Yakut Range, about 5 klm wide, follows next and after reaching an altitude of 1100-1200 m, abruptly descends to the N, towards the Timirdyakh valley, the bottom of which lies at a height of 400 m; the southern slope of the Yakut Range, although not so abrupt, is steep enough, The greatest heights in the Yakut Chain, as in the Dividing Range, are situated to the east of the Tukulan road (where the Yakut Chain seems to be known by the name of Sordoga), while to the west of that road the Range rapidly loses its identity and splits into a number of separate ridges or blocks, rising directly above the plain.

The Yakut Range, to the left of the Tukulan, is bordered on the south by a low plateau, gently inclining to the S, 400-450 m high, with an all but flat even surface, although formed of rocks of Jurassic (possibly Cretaceous) age, which are collected in folds.

West of the Tukulan this plateau is buried under a layer of sediments constituting a vast accumulation of terminal moraines of an altitude of 315 m above sea level. At some distance south of this the plateau can be unmistakably recognized on both sides of the

Tukulan, forming at the same time the Mollegoi hills which extend across the river and rise some 10-20 m above the neighbouring country. Still more to the south moraine accumulations may be met with 20-30 m above the Tukulan, generally forming narrow ridges disposed in a latitudinal direct-[190] ion; they are also more or less well expressed in the moraine landscape north of the Mollegoi hills."

28: Grigoriev--190-194 N-5 (1925) 1926 Yakut -1-7
116, 133

"North of the Dividing Range the mountainous country, as has been shown, very gradually diminishes in height. Receding somewhat from this Range two ancient elevated surfaces of denudation may be observed, the lower of which lies 100-150 m below the higher and is represented now by broad, flat summits, while the latter possesses more sharply indented ridges. In the region of the Yana (Sartang) this lower surface of denudation lies at an altitude of 1100-1150 m, in that of Tangkalakh R. at 1300 m, and in that of the sources of Nyalgyakhya R. at 1300-1350 m. In closer proximity to the Dividing Range this lower surface of denudation covers relatively small tracts, which skirt the valleys, whereas northward it is spread over ever increasing areas at the expense of the more highly elevated denudated surface, until still further north this latter is completely superseded by the former.

The upper denudated surface, although occasionally exhibiting a markedly disjointed and consequently somewhat disturbed relief, is also not unfrequently varied by the occurrence of flat surfaces studded over with protruding ridges and summits of a more or less sharp outline, to which it forms a pedestal.

The ancient lower denudated surface seems to have been formed by the processes of erosion and denudation, due to an activity heightened by the upheaval of the country above its former level, which was then considerably lower than it is at present. In no other wise can be explained the rapid development of these processes. On the southern slope of the Range very little has remained of these denudated surfaces; possibly the most

extensive of these remains is the folded residual plateau lying to the south of the Yakutsk Chain.

Such a difference in this respect between the southern and northern slopes of the mountainous region is connected among other things with the vast preglacial upheaval of the latter having caused a rapid dissection of the relief; and, as a matter of course, this process has gone much further on the steep southern slope and has there effaced the major part of the former surfaces of denudation, whereas on the gentler northern slope it has been restricted to the deepening of valleys. Intervening glaciation has produced the least effect upon the second [191] surface of denudation, which appears at that time to have been covered with firn fields and ice of the Scandinavian type; whereas the river valleys, transformed into beds of mountain glaciers, had under the influence of the latter unrecognizably altered their character. The activity of ice has powerfully affected the forms of the relief of the Dividing Range, the then centre of glaciation. All the ridges and slopes of this Range bear a purely alpine character: occasionally glacial 'karrs' occur on its highest summits.

No less characteristic are the river valleys in the shape of typical troughs with wide bottoms, in no wise corresponding to the breadth of the present river beds, with nearly vertical sides, hanging valleys of their minor tributaries, and steep alluvial cones. Particularly striking is the very deep depression of the valleys, in consequence of which the rivers, even in their uppermost course, in spite of the rapidity of the current (the

fall being about 10 m to 1 klm), are unable to effect any deepening erosive activity. As a result of such conditions the rivers deposit sediment in their upper reaches and break up into channels, exhibiting phenomena usually characteristic of their lower course.

The same causes produce a very considerable swamping of the valley bottoms, as these latter are but very indifferently drained by the rivers running down them. The extensive development of glaciation in the Verkhoyansk mountain region is manifested besides in the wide distribution of boulder loams and sandy loams over both the valley bottoms and the elevated surfaces of flat ridges. Finally, in the valley of Tukulan, and in those of the northern slopes, evidence is universally afforded of the remains of the glacial bed bottoms forming elevated terraces of native rocks with an undulating surface, not infrequently covered by a moraine mantle. Of such terraces there are generally two, which in the Tukulan valley lie at an elevation of 20-40 m and 70-100 m respectively above the water level of the river; in the valleys of: Kieng-Uryakh at 7-15 m and 35-40 m; Tangkhalakh at 3-5 and 100-130 m, and Nyalgyakh at 7-15 and 40-50 m.

The above leads to the conclusion indicated by some observations made earlier, that these valleys were subject to no less than two epochs of glaciation. It may be noted besides that in the Tukulan valley typical 'riegels' occasionally occur (especially [192]

in the region of the distribution of dark grey calcareous limestones) and in the valleys of the northern slope transverse 'troughs' are not infrequently very well developed. All the mountain passes visited by the author represent the results of the activity of the glaciers, or rather of their lateral branches passing over the ridge into the neighbouring valley. Many of these passes contain small lakes of an undoubtedly glacial origin. As the route of the author did not extend beyond the region of glacial phenomena, he was unable to ascertain its northernmost limits; judging from the observations of other explorers it may spread as far as the ocean. As regards the southern slope the terminal moraines were found by the author to lie immediately south of the Yakutsk Chain on the one hand and between the Mollegoi hills and the Aldan on the other. These last may be distinguished from the first not only by possessing less typically prominent forms of relief, but by the horizon containing boulders on elevations underlying a thin (40 cm) layer of boulderless loam, similar to that which is widely spread over the Lena-Aldan plateau south of the Aldan, where it cannot but be regarded as a formation deposited during the period of the most recent glaciation. These circumstances afford full grounds for looking upon the moraines accumulated between Mollegoi and Aldan as a terminal moraine of the first glaciation, while a similar accumulation adjoining the southern foothills of the Yakutsk Chain and bereft of the boulderless mantle may be regarded as terminal moraines of the second glaciation.

Thus, the geological history of the Verkhoyansk Range, in so far as it can be ascertained, may be presented as follows. The area of the future Range was originally collected in folds at the end of the Paleozoic era, when it first became land. After a considerable period of denudation it was invaded anew by the sea, when Mesozoic strata were deposited upon its surface. At the end of the Cretaceous (?) period this region was subjected again to an intense process of folding, resulting in a relatively low, folded mountainous tract, which slowly emerged from beneath the level of the sea. A continuous alteration in the direction of the strike of Mesozoic rocks shows that the folding was not only caused by the pressure of the masses of ancient rock, situated to the N and S of the Range, but hindered in its free development by the resistance afforded by similar masses from W and [193] E. Meanwhile, the Paleozoic strata underlying the base of the Mesozoic deposits of the Range in consequence of this second period of contortion became very much disjointed in three different directions by fissures, which tended to mask the true direction of the strike of the rocks.

The period of folding processes, at least throughout the area of the southern slope and of the foothills of the Dividing Range, was followed by a series of faults. As a consequence of these latter arose the heaved block of the Yakut Chain, as well as the vast depression south of the Mollegoi hills, extending from that Chain to the outcrop of

Mesozoic (apparently Jurassic) country rocks of the Lena–Amga plateau, situated in a lower latitude than Yakutsk. The work of erosion and denudation, by which in the meanwhile the Range was moulded, had also given rise to a surface of denudation, very much resembling a plain with residual elevated summits rising above it. In connection with a renewed upheaval of the country a softly rolling denudated surface had widely spread over the area lying north of the Dividing Range and in the shape of separate tongues (corresponding to the respective river valleys) had cut its way into the more elevated parts of the Range; on the south, this surface is represented by a flat folded residual plateau extending from the Yakut Chain to the Mollegoi hills. This period was followed by a new upheaval or a notable acceleration in the elevation of the old, which caused the rivers to cut their beds deeply into this second denudated surface. Towards the end of the period of upheaval the Range was subjected to glaciation, in consequence of which the more elevated parts of it assumed alpine forms. In the meanwhile, the tracts of the second denudated surface lying at a lower elevation, at least in the region of the higher parts of the Range, were buried beneath the ice of glaciers, with which the neighbouring valleys were filled. These glaciers cleared the denudated tracts of ancient sediments, with which they were covered, locally enveloping them with their moraine deposits, and transformed the more or less oblique slopes by means of which these tracts were joined to the more elevated parts of the mountains, into precipitous, frequently all but vertical walls. Judging from the traces that can still be observed the

glaciers of the First Glaciation reached a thickness of 350 m above the level of the valley bottoms in the Yana valley and of 100 m in that of Kul Tangkalakh; the thick-[194] ness above the denudated surface was thus not great, scarcely exceeding 150 m in the region of the Yana, and 30-50 m in that of Tangkalakh, whence their eroding power could not here have been very considerable. Conversely, in the regions of the preglacial river valleys themselves, where the ice had reached its relatively greatest thickness, and the character of its motion was different, its action was very powerful, in consequence of which these valleys underwent the most violent changes.

The process of glaciation seems to have been repeated twice, an interglacial period intervening, as is evidenced by the presence of two systems of elevated undulating terraces (former beds of glaciers) as well as of two belts of terminal moraines at the southern base of the Range. After the end of the Last Glaciation the beds of rivers had somewhat, although but very slightly, cut into the bottom of the glacial valleys, subsequently to which, however, these rivers had obtained senile features in their upper reaches.

The question remains undetermined, whether these latter should not be exclusively ascribed to the energetic deepening of the valleys by glaciers or else perhaps to the postglacial sinking of the mountainous country as well, which last alternative for various circumstantial reasons seems more probable. (1)

1. See Addendum, p. 200."

ADDENDUM

to page 194.

After the major part of this work had passed through the press a series of new facts somewhat modifying the views stated therein have been disclosed during the author's second visit to Yakutia in the summer of 1926. Observations made then in the north-western part of the Vilui basin (on the river Tiung), as also on the shore terraces between Kachug and Yakutsk, much facilitated by the favourable weather conditions of that summer, lead to the inference that three ancient surfaces of denudation with residual eminences raised above the upper surface are present throughout the country. In instituting a comparison between these observations and those of W. J. Zverev relating to the middle course of the Aldan (1) (below the affluence of the Uchur) and to the

1. See W. Zverev. Brief report on geological investigations conducted in tre valley of the Aldan. Izv. Geol. Komit. 1913. Nr. 4.

Vilui above the mouth of the Akhtaranda, it appears that the entire Lena basin had been thrice subjected not only to periods of upheaval, but to a rigorous activity of running water. This circumstance stands in full agreement with the conclusions reached by

S.S. Neustruev (2) from observations made in the southern parts of Western Siberia

2. See S.S. Neustruev. Contributions to the study of Quaternary deposits in Siberia. Pochvovedenie, 1925, Nr. 3.

which the author mentioned connects, so far, it is true, but 'advisedly', with the three-fold glaciation of the Altai established by Granö. (3)

3. See Granö. On the Glacial Period in the Russian Altai. Izv. Zap. Sib. Otd. Russk. Geogr. Obshch. III. 1923 p. 11-21, and also his: Les formes du relief dans l'Altai russe et leur génèse. Fennia, m. 40. 1919.

The above affords sufficient grounds for admitting that the Verkhoyansk Mountain Chain in the Postpliocene age was subject not only to three upheavals, as has been shown by the author in this work, but to three periods of glaciation (instead of two). The first period embraced the Tertiary peneplain, the [201] second was connected with the elevated surface of erosion cut into this plain, and the third with the lower glacial terrace. Therefore, everything which is attributed in this volume to the agency of the ice of the first period of glaciation should be assigned to that of the second period, and

what is connected with the glaciers of the second period should be relegated to those of the second. The first period of glaciation apparently yielded in intensity to the second, in consequence of which the relief has lost many forms connected with that age and among them independent systems of terminal moraines."

46: Cottrell --114-116 T-2 (1840) 1842 Yakut -1-2
116, 133, 136

"In this part [RCH: in the district around the Kolyma, Anyui and Indigirka Rivers] of the East Siberia, vegetation ceases at the 70th degree of north [115] latitude. All is tundra and moss beyond this; but the lakes are larger and more numerous, and the marshes stretch far and wide. There is one of these lakes called by the Yakuts tastakh, which signifies full of stones, remarkable for a quantity of bituminous wood which it throws up. In it are found pieces of petrified rosin, quite clear like amber, and sometimes containing insects incrusted in them. It seems, however, to be lighter than amber, (we have some specimens of it,) and when burned, has not the agreeable smell. Great quantities of wild-fowl have their haunts here, among them two sorts of wild-geese not common in other places: qne, smaller than the grey wild goose (férus) is quite white, except the tips of the pinions, which are black, and the foot and tibia red. The other is quite black, and called in Russian némok, because it utters no cry in flying: it is the size of a large wild-duck, but in form more round. Two sorts of swans only are found here, one large and one small. The large one always builds in the woods off the tundra; the little one always on the tundra, where there is no wood. There is a curious little snipe (Tringa lobata of Linaeus,) the size of a sparrow, and web-footed, so as to be able to swim. It is also found in the Barabinski Steppes. The brigand gull

(Larus parasiticus) frequents these parts, but no others in Siberia. The white partridge (Tetrao lagopus) and white owls, are the only birds (not water-fowl) that winter here. The great elk (moosdeer of Pennant) pastures on the borders of the tundra, but never leaves the woods. They are very large, one of a year old being the size of a horse. The argali (Capra Ammon) are found on the east of the [116] Kolymá, as well as on the southern frontier, and mountains within the Chinese territory."

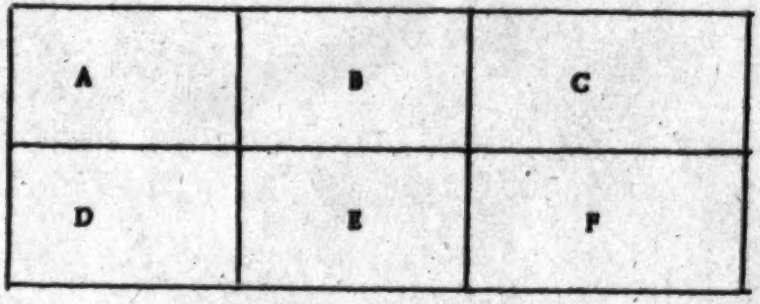

Chart of Positions of End Map
[Facing End Map]

/144 cont./

122 the statement concerning the date when the report was re-
123 ceived in Wiljuisk agreed with its dispatch. /The remainder of p. 144, p. 145, and the first two paragraphs of p. 146 are omitted in the translation; see the foreign text. Page 146 continues as follows./

On September 7, at the mouth of the very considerable left tributary Ukikít, as Temír Jegór had prophesied, we met his older brother Nikofór, who held the position of a dessjátnik (a community office). While I made magnetic observations in spite of the bad weather, he told Czekanowsky something about the further course of the river, the places where people were to be found, and the like. In general, I must note here, the results of such inquiries are reliable to some extent only when they are made from different persons, completely /147/ independent of one another. All statements about distances are particularly unreliable; the number of days of travel is most indefinite, as we had opportunity to experience often enough. In addition there is the very common deliberate twisting of the truth, especially with reference to the trade routes. Since the Jakuten /Yakut/ settled here on the Olenék are all more or less middlemen between the Russian traders on the Lena and the Wiljui /Vilyui/, on the one hand, and the Dolgan on the Anábara, on the other hand, it is obvious that they do not want to be seen on the maps by strangers whose intentions they do not know. Such a route passing by Temír Jegór's dwelling place led to the Dolgan.

122 On September 7 we passed a second considerable left
● 133 tributary with an especially wide mouth, the Bírekta, and on the next day the likewise quite large Butt. The tributaries from the right side are insignificant, for here the Lena with those belonging to it already comes too close. Unfortunately we could only supply ourselves with meat from Nikofór; we could not get a guide here either, because his son had gone to look for stray reindeer, which, it seems, is one of the chief occupations of these uncivilized peoples. /The last paragraph on p. 147 and the first two paragraphs on p. 148 are omitted in the translation; see the foreign text. Page 148 continues as follows./

/175 cont./

137 The timber line now passed by us lies at 71 1/2° latitude. It is not fixed very precisely, for individual streaks of forest extend tonguelike into the tundra, and here and there one finds smaller or larger islands of forest, so that here the transition from forest to tundra, in contrast to what we saw earlier, was a very gradual one. Lone before our last camp it was noticed that the forest was becoming steadily poorer and more stunted, and from there the signs
122 of its imminent cessation multiplied. On the next day we crossed the watershed between the Pur and the Boljkalák, the last large tributary of the Olenék. Since it was no longer snowing we advanced quite rapidly, but when it became dark we had still not reached by far our camping place designated for tonight by the guide, but rather only a very small hut in the middle of the tundra, which we used to revive ourselves somewhat. Then we continued our journey in the darkness and finally reached a small, but cozily warm balagan on the little river Molokó, which empties into the Boljkalák. On the next day we followed the course of this little river and then the Boljkalák itself, but our /176/ guide, in shortening the route by cutting off the bends, multiplied its difficulties and in crossing the steep sides of the bank our narten, and we with them, frequently took a fall. Otherwise Czekanowsky
[133] was very satisfied. The rocks here decidedly no longer belonged
[134] to the Silurian formation which had become so very boring to us, for coal appeared, but unfortunately no petrifactions.

122 In the evening--it was October 20, that is, exactly four
123 months since we had reached the river system of the Olenék at
621 the Ljútscha Ongókton -- we found ourselves at the goal of our long journey, at the little village of Boljkalák lying at the mouth of the Boljkalák into the Olenék, officially Ustj-Olénskoje, i.e., mouth village of the Olenék, and stopped in front of the stately balagan of the local elder, which had been assigned to us for a
[574] dwelling. Informed previously about our imminent arrival, the entire male population -- it was an imposing crowd; we at least had not seen so many people together for a long time, but in all only seven families are said to live here -- stood ready to welcome us and greeted us with low bows as we climbed out, while upon entering the balagan we were received by the ladies of the house.

/199 cont./

122 governor of Jakutsk /Yakutsk/, who immediately agreed to thank
123 the honest Jakuten /Yakut/ personnally for the help given us. To our great pleasure, our old friend /200/ Atschkássow was assigned to us as courier for the journey as far as the border of the Ulússes, and he willingly accepted this decision of his colleagues, although we had already laid claim to his services for such a long time.

We were glad to be able to show our appreciation in some measure at least for the great services rendered to us here by leaving for our friendly hosts the rather considerable remainder of our powder, an article always greatly prized here, but now regarded as especially precious because the annual government shipment of powder had failed to appear this year. Atschkássow, of course, was as richly rewarded as our means allowed. My powder horn, which I believed to be no longer necessary in the continuously prevailing temperature of 30-40° R. below zero, delighted him greatly, and even more a Chinese cap which I had bought in one of the many Chinese stores in Irkutsk. The latter, to be sure, was so unique that it would have attracted attention even in Europe; that is, it consisted of two half-circles of fine brown felt lying one inside the other, which, upon being pulled apart, formed a hollow, egg-shaped body on which one could not detect the tiniest seam. I have been told that these caps, very cheap incidentally -- mine cost one ruble 20 kopecks in Irkutsk -- were made by pressing the mass of felt on a form of ice, which later melts. Any other way of making them is indeed inconceivable.

122 On the morning of November 8, we set out again in a
● 133 temperature of -35° R. The sun was no longer rising for us on
[32] that day, but for a long time the southern sky glowed with the most beautiful colors. First we went up the valley of the little river Ebetén, which empties into the Lena not far from Küssür and distinguishes itself unfavorably because of much Aufeis /surface ice/. One /201/ recognizes this by the blue or green color and avoids it whenever possible, for often, under a relatively thin covering of ice, one encounters large hollow spaces or even flowing

/201 cont./

122 water, the latter of which, even though not deep enough to en-
● 133 danger the traveler himself, can, because of the intense cold, be a hindrance to the reindeer and, in addition, covers the runners with a crust as hard as stone, which makes progress very difficult. As it is, in intense cold, the runners must be freed of the clinging ice every day before setting out. The Ebetén comes out of the Chara-ulách Range, which, forming a branch of the Werchojánsk /Verkhoyansk/ Range, runs a long way along the right bank of the Lena. From Ssiktjách on we had admired its
[137] picturesque forms along the other shore of the river. Moving up the valley of the Ebetén, we soon found ourselves on the tundra again; only in very sheltered places did we now and again see a few larch trunks. Probably only the high altitude has robbed this region of forest growth, but this mountain tundra, just like that along the shore of the Olenék, changes directly into the sea tundra.

122 We spent the night in a balagan that was still in the Ebetén valley and on the evening of the next day, after climbing over a low pass in the Chara-ulách Range, cutting across the Chara-ulách River, and then moving down the valley of the Gõlynkaĭ River, again reached the vicinity of the Arctic Ocean, which forms a deep bay here. About eight or nine versts from the sea-coast lies the balagan Tass-Tumúss, where the roads to Ustjjansk /Ust-Yansk/ and to Werchojansk /Verkhoyansk/ intersect. We could not have wished for more comfortable quarters. We admired the enormous beams of our dwelling, which were several feet wide -- they had evidently /202/ been carried down to the sea from the distant south by the force of the currents and then, perhaps after being tossed about for a long time, had been deposited on this inhospitable shore; indeed, who can say whether they even grew on Asiatic soil or reached here from American shores by means of some still unknown ocean current. Animated by the merrily dancing fire of the fireplace, we found pleasure in the thought that now at last we would actually be turning away from here to the south, to where -- perhaps only after many weeks -- we would see trees like those that now sheltered us from the cold breath of the Arctic Ocean. Many a traveler before us had probably indulged in similar thoughts here; the inscriptions on the

/207 cont./

136 but since then have completely disappeared. They are therefore also retreating southward here just as along the Nishnaja /Nizhnyaya/ Tunguska. The wild sheep (tschubukún) found farther south in the Werchojansk Range had been heard of, but they are not found here even in the rockier parts of the tundra, although there, as well as here, marmots (tarbagán) are very common.

226 Our host also engaged in fishing with great success at the
439 mouth of the Omoloí, the yield of which -- mukssún, o'mul, tschir, and néljma -- except for what he uses himself, he for the most part exchanges for furs in Ustjjansk /Ust-Yansk/.

122 On the next day we continued our journey almost due south
13 and passed a very populous balagan, which was named for us as Iggitauýt, as well as several tributaries of the Great Omoloí, which lies to the east of the Little Omoloí which we had already crossed. We were told that the region abounded in swamps and lakes that were full of fish; the forest, although somewhat taller than that of the previous day, was still very poor in comparison with that found at the same latitude along the Olenék, alternating with great tundra-like plains. In general, it seems as though in the far north the /208/ extensive plains are not favorable for forest growth and that it remains relatively vigorous only in the more uneven terrain even up to very high latitudes. In the afternoon we reached the stan Dshüssál on the lake of the same name, where I decided to make some astronomical observations because of the exceptionally mild temperature of barely -20° R., according to which we were at 60° 38' latitude.

On our further travels the next morning we were surprised after a short trip along the shore of the Omoloí in the vicinity of the settlement Ojóma by a little grove of poplars (Populus suaveolens Fisch.). This poplar, according to the natives, reaches its northern boundary here, but has such small trunks that they are unfit for working. On the day before we had noticed many
● 133 willow thickets in all the river valleys that we crossed. From
122 Ojóma on a broader view of a quite considerable mountain range

/208 cont./

133 taking in the whole southern and part of the eastern horizon,
122 over which our route was to take us, opened up before us -- the Kullár Range, which, running in a northeasterly direction, seemingly parallel to the Chara-ulách Range, forms the watershed here between the Omoloí and the Jana /Yana/ basin. Although both the Kullár and the Chara-ulách ranges are probably only spurs of the main watershed between the Lena and the Jana, whose collective name, however, we could not discover, their appearance here is very different. Instead of the frequently picturesque, jagged, often conically-shaped peaks of the Chara-ulách, here we saw only massive rounded heights with steep
[137] slopes and broad flat valleys in between. After we had traveled about five versts from the Omoloí across a completely unwooded plain, we reached the /209/ foothills rising steeply, but not high, and covered with woods, and finally, after another six to eight versts, the completely treeless heights of the mountains; in the valley of an insignificant tributary of the Omoloí, the Kylagóttu, we reached the altitude of the pass, which rises at least 1,300 feet above the Omoloí and is topped by the surrounding peaks by
[136] another 400-500 feet. Here, by the way, we saw only a lower
[192] part of the range, which is said to reach much greater heights in the source area of the Omoloí, which is to be seen merely from the fact that wild sheep (tschubukún) are said to be found there in abundance, while they are still absent here.

122 13 Directly after the watershed we reached an insignificant brook, Kargýchala, already belonging to the Jana basin, down whose broad valley, running southwest, we soon reached the little river Tass-Apká and the stan of the same name, which was to serve as our lodging for the night. The southern slope of the Kullár Range is considerably less steep than the northern slope; on the other hand, the tree vegetation on the latter is more vigorous and goes up farther, probably likewise evidence that the climate becomes milder toward the shores of the Arctic Ocean, which was also shown by a comparison of the temperature observations in Ustjjansk /Ust-Yansk/ and Werchojansk /Verkhoyansk/, as well as the completely unanimous statements of the natives.

/209 cont./

as well as the completely unanimous statements of the natives.

122 Our further journey, always in a southwesterly direction, went down the valley of the Tass-Apká to where it empties into the Bytantaí River, where the region was already beginning to [132] become more populous. Everywhere we noted traces of human activity, fences and great haystacks; horses and cows roamed about in the open in spite of the snow falling heavily and the [137] prevailing temperature of about -25° R. The woods also began to look more imposing and we were especially pleased to see along the river banks /210/ now and then quite stately, straight, and thickly-branched trees, not seen for a long time. Unfortunately we were quite unexpectedly delayed here. In the stan Tass-Tumssá, which we reached soon after midday, the station manager, or rather his substitute, absolutely refused to grant us the necessary reindeer for our further journey, and he could not be induced to yield either by our official documents and threats that we would have him punished by the isprawnik /ispravnik/ or by the remonstrances of a Jakuten /Yakut/ elder who happened to be present. The latter, since he did not reside here, could only put his own two reindeer at our disposal, and thus it would have been difficult for us to do anything but turn for help to the authorities at Werchojansk /Verkhoyansk/, by which we would have lost several days at least, had not our guide up to here, Iwan Borogón, been kind enough to undertake our further advance to Werchojansk with his own reindeer.

122 On the next day we crossed a mountainous region and climbed ● 133 three ridges, Kuwaláss, Idomopút, and Kyrá, the middle one of which was quite insignificant, while the two others also seemed to rise only about 700 feet above the last night's lodging, and spent the night in the stan Tykák on the river of the same name, in the valley of which we covered the greatest part of the next day's journey and in doing so, in order to cut off the many bends, traveled sometimes on the one bank, sometimes on the other. [132] After climbing a ridge, Koptolák, rising about 1,000 feet over the immediate surroundings, we stopped at the stan of the same name, where toward the morning of November 17 I again noted

122 /217 cont./
repugnance against all spirits during the intervals. If a true Siberian at a reception -- and, according to the custom of the country this takes place in connection with every visit in the form of a so-called sakússka, i.e., a variety of spirits along with the necessary spiciest possible morsels to bite on (the direct translation of sakússka) /218/ -- does not accept the customary grain spirits (otschísch-tschennoje, i.e., purified, sc. whisky), but excuses himself in embarrassment, the chances are at least ten to one that he is a victim of sapoí. The drinking of spirits in itself, even within limits that somewhat exceed those customary in Europe, does not seem to be harmful in any way here, but rather to be strengthening, particularly for Europeans and their descendants. The fact is, as I can testify from my own experience and that of many of my European acquaintances, that the intoxicating effect of spirits is much weaker in Siberia than in Europe. Czekanowsky and I were emaciated during the Olenék expedition, on which we had to get along without any alcoholic beverages at all for about half a year, but with quite adequate nourishment
273 on the whole otherwise. Liquor certainly does not, however,
171 have this beneficial influence on the indigenous tribes and has a very intoxicating effect on them. I do not know whether the substitutes used in its place by the various Siberian peoples have more beneficial effects. The Burjaten /Buryat/ in southern Siberia get drunk on tarassún, a milk liquor with a most horrible taste; the Tschuktschen /Chukchee/, on a decoction of fly agaric; the Jakuten /Yakut/ even on enormous quantities of butter which they devour in a liquid state by the pood (pood = 40 pounds) and thus put themselves into a drunken-like stupor. /The last paragraph on p. 218, pp. 219-229, and the first paragraph on p. 230 are omitted in the translation; see the foreign text. Page 230 continues as follows./

122 On the next day /December 1/ we reached the last station,
● 133 Kŏng-urách, before the watershed of the Werchojansk /Verkhoyansk/ Range. The mountains came ever closer to our route, but the ascent was so gradual that without watching the barometer we could scarcely have imagined that we were ascending a high range and
800 would soon be at the height of the pass. At this station we met the

/237 cont./

137 thick trees, standing magnificently tall and close together, with rich and varied undergrowth. Almost all types of Siberian timber appear here together and in such beautiful specimens that one can scarcely believe that they are standing at their arctic boundary -- first the white birch in whole stands of the most beautiful trees, then the mountain ash (Sorbus aucuparia) with its beautiful red berries, which the snow had not yet knocked off, also the black alder (Prunus padus), and the fir (Pinus abies), the latter at first in individual specimens, then in quite magnificent groups, and then, of course, all the other /238/ types of timber found farther to the north -- larch, willow, poplar, aspen, dwarf cedar, as vigorous here as in the distant south. We missed only one forest tree -- the Scotch pine (Pinus sylvestris), but we greeted even it on the following day.

122 Wherever the dense forest occasionally permitted us a view,
● 133 we saw on either side of the valley high, wild, jagged mountains of exactly the same character as those of the watershed crossed by us. On the previous evening it had seemed to me more than once as though a murmur like that of flowing water was to be heard under the stones over which we climbed, but in the uncertain moonlight none was to be found; today in the daylight, however, we saw it quite plainly and were glad to have escaped the danger of falling into the water in the dark and then undoubtedly freezing our feet. Middendorff in his work speaks a good deal about this peculiar phenomenon which is closely related to the Aufeisbildungen / surface ice formations/; nevertheless a truly satisfactory explanation cannot yet be given. Water flowing for quite long distances at close to -40° R. is certainly difficult to explain, even though one thinks of hot springs, which do come into it. Only very detailed local observations in all seasons of the year, which, of course, the naturalist passing through cannot undertake, make it possible to solve such puzzles.

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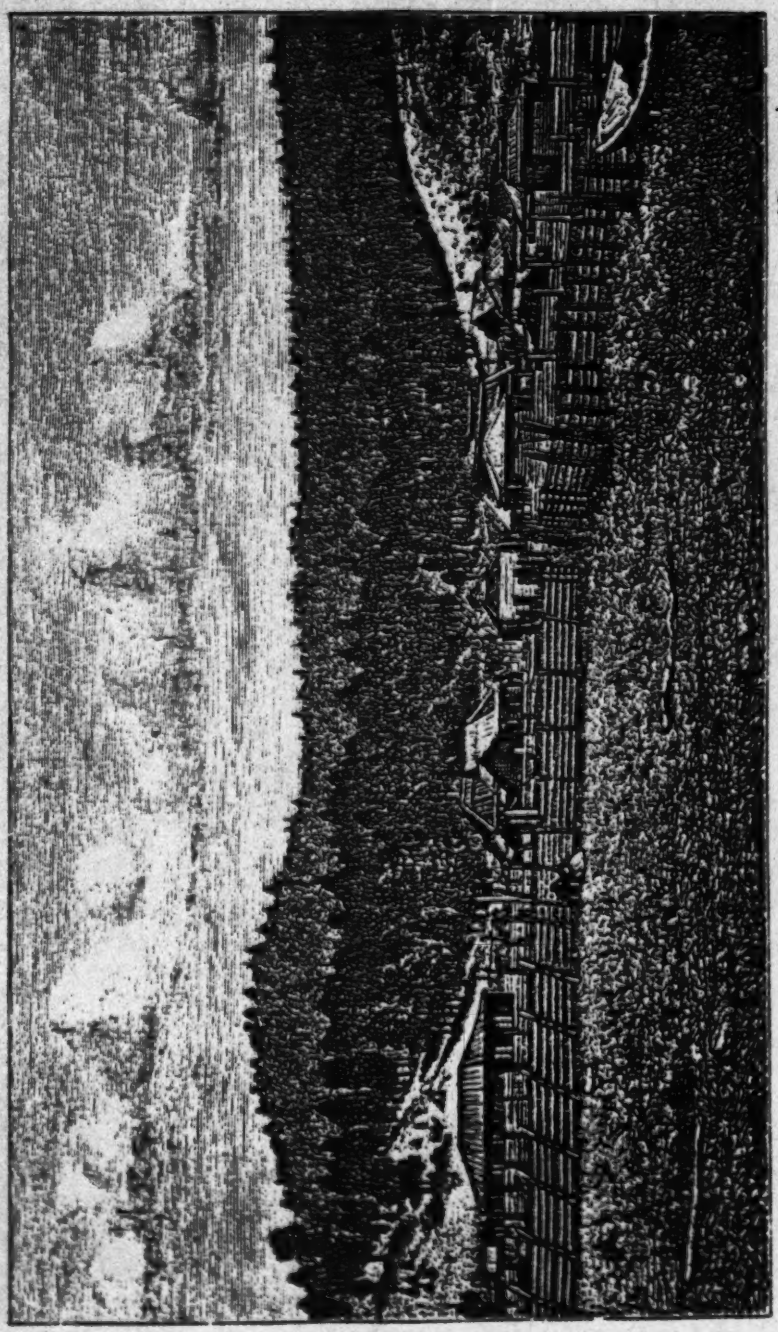
122 After a seven-hour trip -- the distance could at most amount
136 to 45 versts -- we reached the station of Bodogóle, where the inhabitants told us something about the hunting here. Concerning big game here, there is first of all the common mountain sheep
[321] (tschubukún), whose meat is said to be very tasty. The skin is also highly valued and carved work is made out of the horns; /239/ we saw only a few small spoons very simply worked. The elk is found everywhere; on the other hand there are hardly any beasts of prey at all, at least no wolves, which are found only to the north from the mountains to Kŏng-urách, but then are completely absent as far as Jakutsk /Yakutsk/; the glutton, whose pelt is eagerly sought by the Jakuten /Yakut/ for fur caps, is found only very rarely; as for fur-bearing animals, there are many squirrels (also flying and striped ones) and ermine, and, it seems, sable.

122 Below the station of Bodogóle the mountains west of the
●[133] route become lower and eminences covered with forest appear. To be sure, on the right bank of the river Antimirdjách one again sees barren peaks, but they soon recede and the range then disappears altogether. Once again on this day, at the end of a very wretched trip, we had to resort to a log house built in exactly the same style as the one of two days before. The local name for these houses is powárnja, i.e., kitchen. Although this powárnja had been built only a few months ago, it was almost of even less use than the earlier one, and again we had to sleep in our traveling clothes. Fortunately it was for the last time, for the day's trip of December 5 brought us to the station of Tánda, which lies on the left bank of the Aldán, and from here on a more densely populated
439 region begins. Before we reached Tánda we met the Jakutsk
484 merchant Gawriíl Feofánow Ssolowjów with his entire caravan, who likewise carries on trade with Kolýmsk, although not directly, but rather by way of the settlement Rússkoje Ustje (i.e., Russian river-mouth) on the Indigírka. We were interested to learn from him -- we had stopped at a yurt along the way -- that he had formerly sent regularly organized expeditions to the New Siberian Islands, which had brought back to him rich booty in mammoth tusks. He had /240/ not undertaken any for many years because

51: Müller--152 N-2 (1873-1875) 1882 RV2 Yakut RV2



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Shérbinsk /Zherbinsk/ Station on the Lena.

[END MAP -A]

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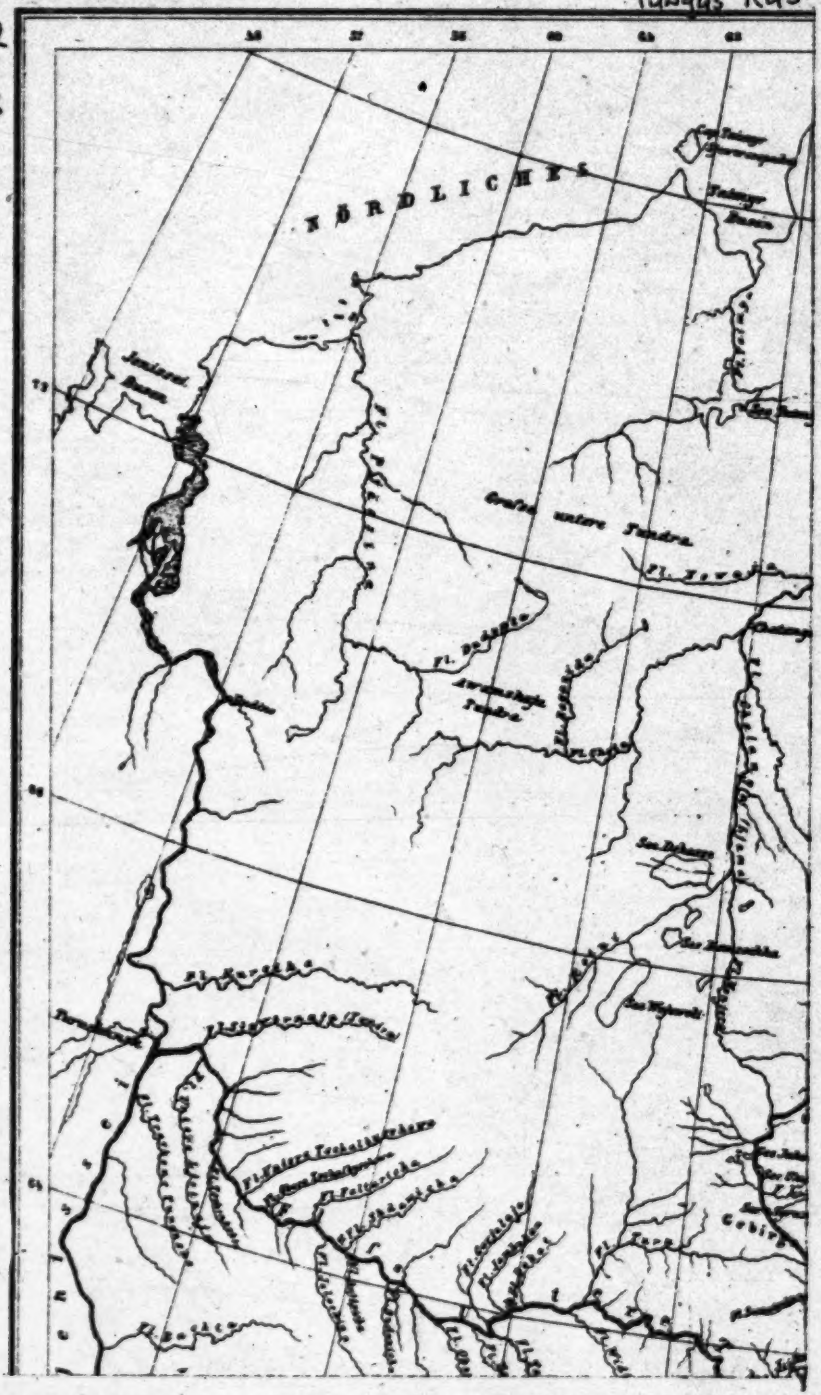
51: Müller--186 N-2 (1873-1875) 1882 RV2 Yakut RV2 ●
Tungus RU5



51: Müller--187 N-2 (1873-1875) 1882 RV2 Yakut RV2

[End map - B] Tungus RU5

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51: Müller--188 N-2 (1873-1875) 1882 RV2 Yakut RV2

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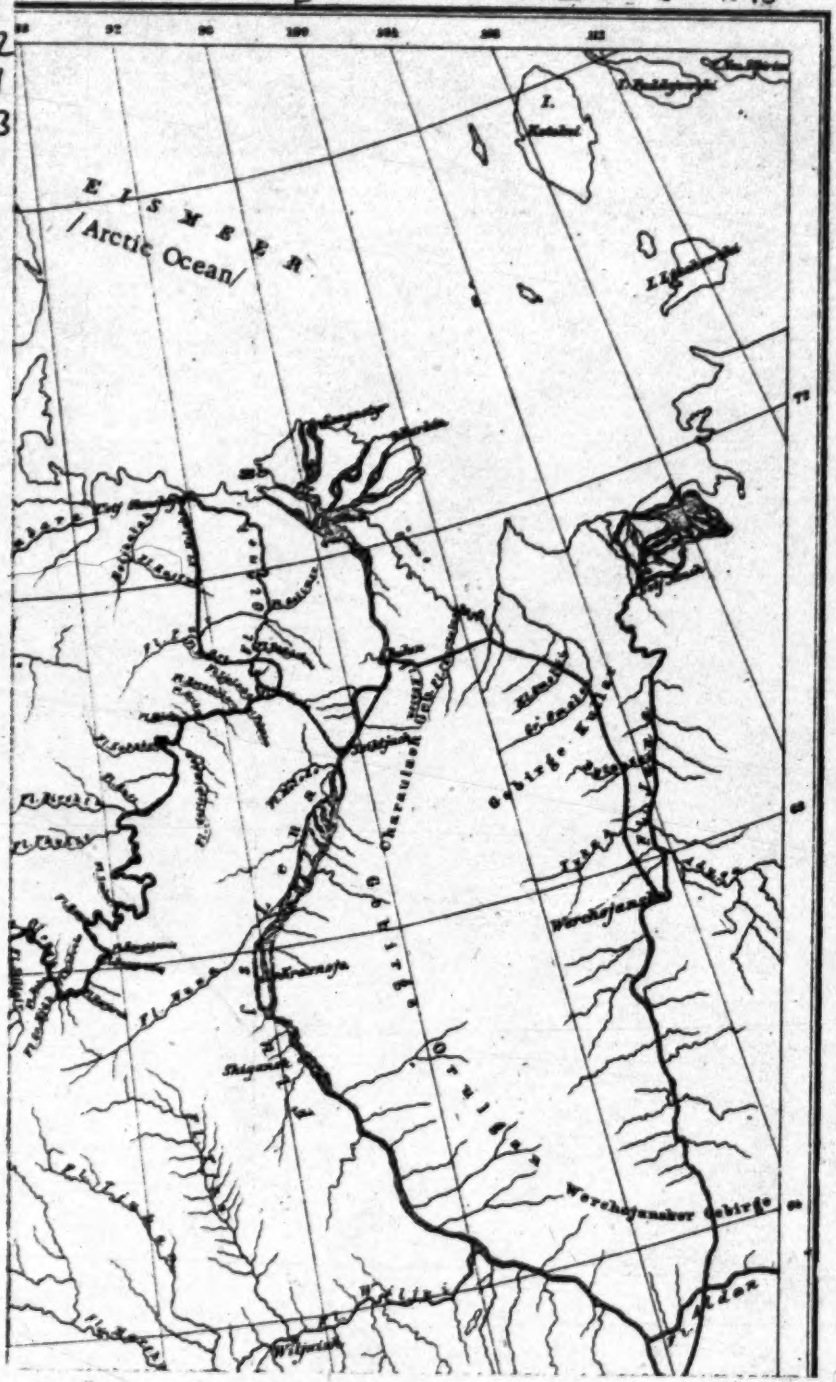
[End Map- C] Tungus RV45



51: Müller--189 N-2 (1873-1875) 1882 RV2 Yakut RV2 ●

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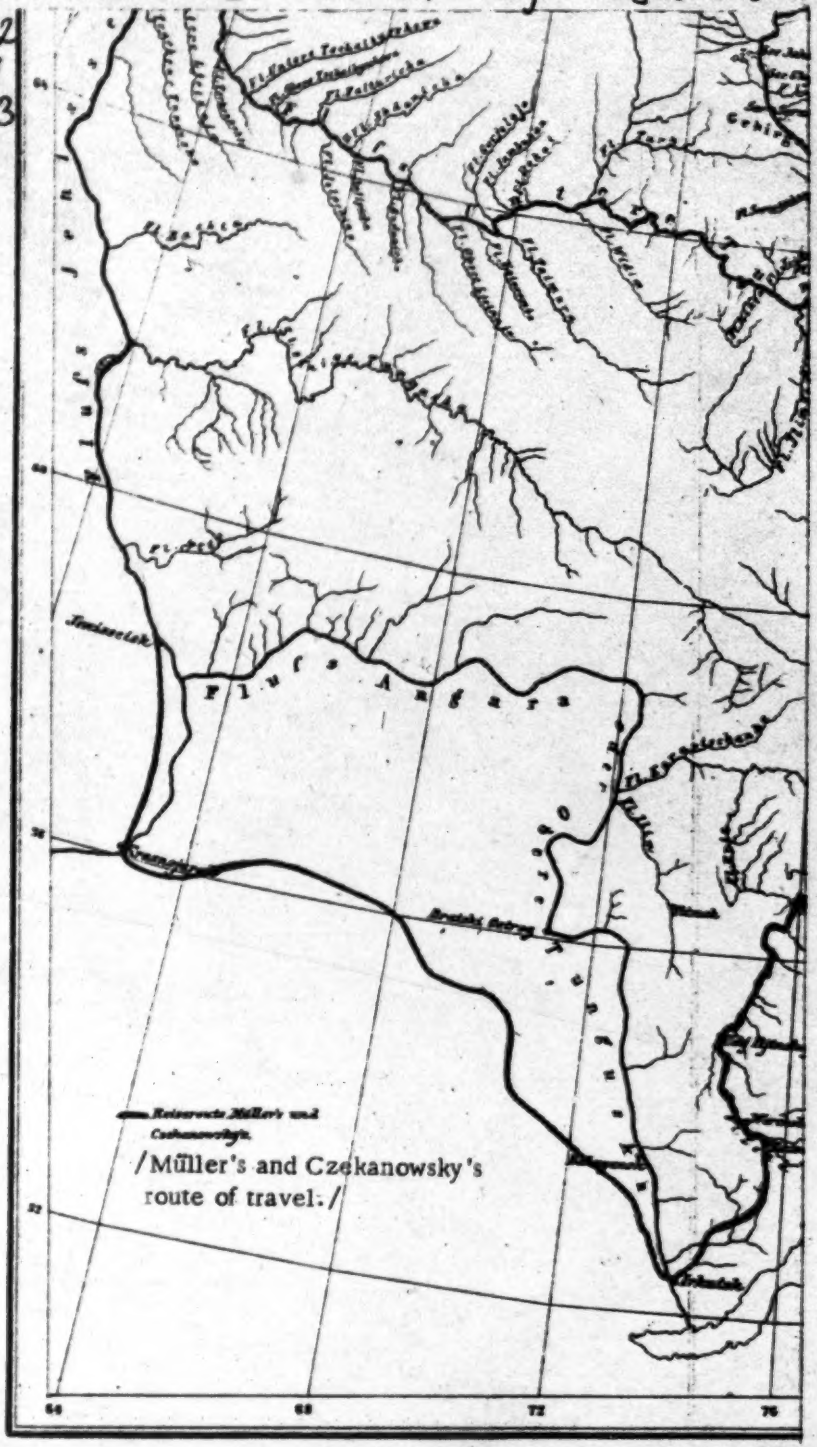
[End Map - D] Tungus RU5



[End Map - E] Tungus RV5 ●

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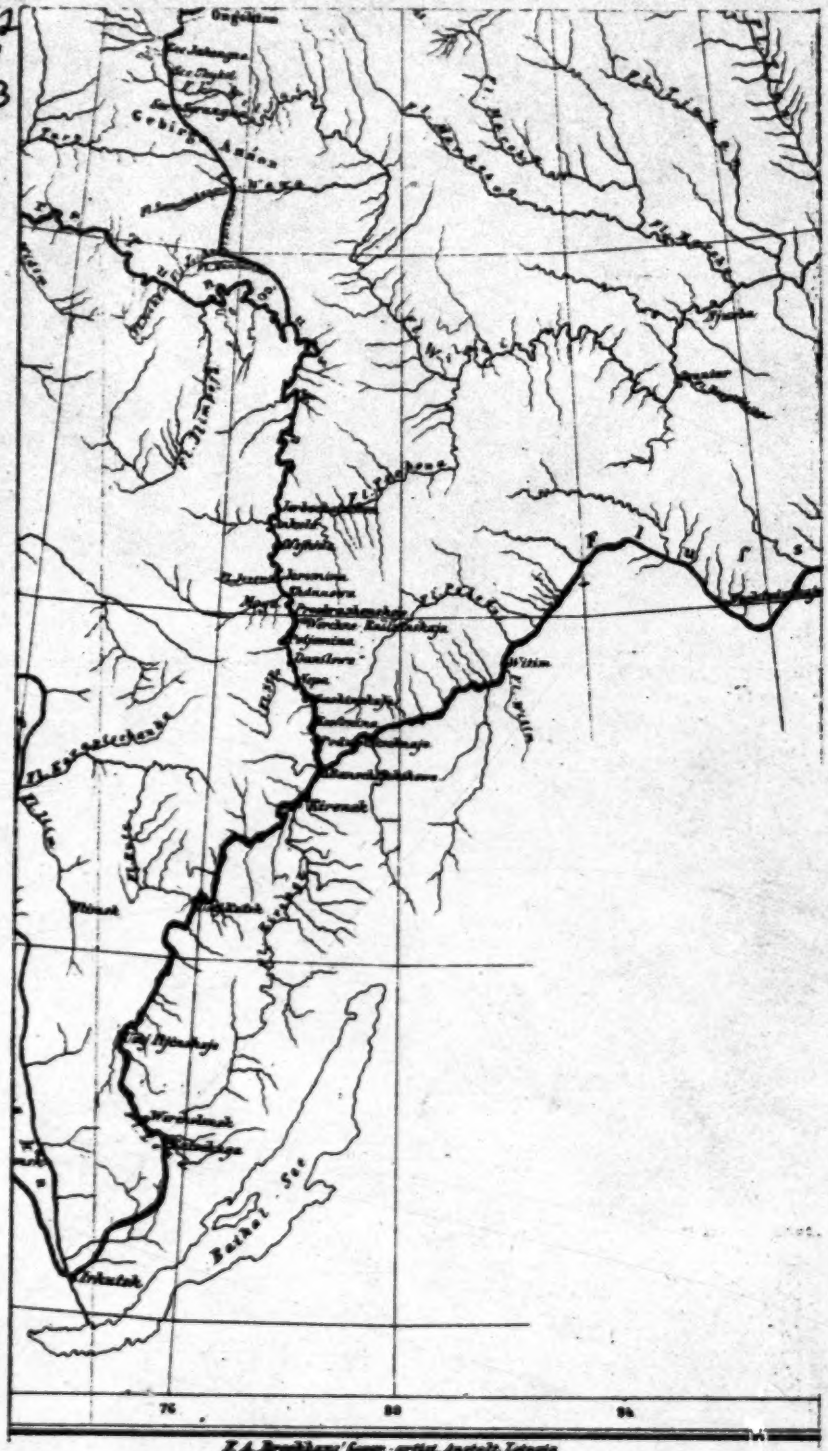
51: Müller--190 N-2 (1873-1875) 1882 RV2 Yakut RV2



[End Map - A Turgus RU5
T 51: Müller--191 N-2 (1873-1875) 1882 RV2 Yakut RV2
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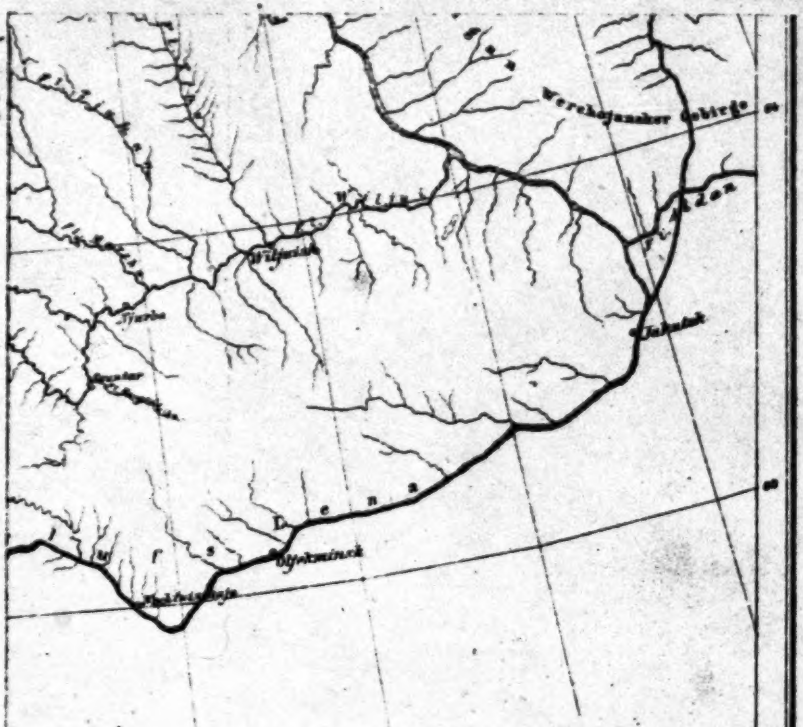

General Map
of the
Northernmost Part of East Siberia
between the Jenissei / Yenisei/ and Jana / Yana/ Rivers.

From the surveys
by
Ferdinand Müller and Alexander Czekanowsky.

Scale 1 : 7,840,000.

7 versts - 1 geogr. mile

Leipzig: F. A. Brockhaus.